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Guidebook 29

STRATIGRAPHIC NOMENCLATURE IN THE UNITED STATES

By

JOHN B. REESIDE, Jr.

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This guidebook contains contributions by the following authors:

William C. Alden, United States Geological Survey.
Josiah Bridge, United States Geological Survey.
Charles L. Gazin, United States National Museum.
Edwin Kirk, United States Geological Survey.
John B. Reeside, Jr., United States Geological Survey.
Charles E. Resser, United States National Museum.
James S. Williams, United States Geological Survey.
Wendell P. Woodring, United States Geological Survey.

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INTRODUCTION

A perfect classification of the rocks of the earth would not only provide units recognizable wherever present and a nomenclature universal in application, but it would also most effectively bring out the geologic history recorded in the faunal content, the lithologic constitution, and the structural relations of the rocks. Only a small advance toward such a perfect classification has been made, however, and it seems likely that even a near approach to it is remote—perhaps unachievable. The nearest approximation at present is in the division of the rocks into geologic systems, though even here there is considerable lack of uniformity in the usages of different geologists and organizations. For lesser units more or less local classifications are the rule, and the departure in practice from an ideal classification, both in the actual application of names and in the principles concerning their application, is very great indeed.

At first sight the systems of nomenclature in vogue in Europe seem much more simple and more nearly in agreement with one another than those in vogue in the United States and in these features more satisfactory. Part of this disparity is perhaps due to an important difference in point of view—that of emphasizing a faunal basis of division rather than a lithologic basis. Part of it is perhaps not as real as it seems, for closer inspection reveals in Europe as well as in America a considerable measure of uncertainty and confusion of usage. The geologist must as often in one continent as in the other consider for a given name the locality, the date of usage, and the individual author. Many of the difficulties met in both Europe and America are inherent in any attempt to apply a classification and a nomenclature to a natural system and are therefore not fairly chargeable against

either nomenclature.

Inasmuch as the members of the International Geological Congress may not all be familiar with the basis of stratigraphic classification used in the United States, and inasmuch as it is difficult for anyone to keep in mind the details of the nomenclature used in a relatively unfamiliar region, it has seemed worth while to present a brief summary of stratigraphic practice in the United States and a set of correlation tables showing a European system of nomenclature and representative American systems.

BASIS OF CLASSIFICATION IN THE UNITED STATES

In the United States a very complex classification of the sedimentary rocks has grown up, and with it a complex nomenclature. For the major units, although various departures from European practice have been proposed, especially in the classification of the Paleozoic, American geologists have in the main attempted to identify the divisions commonly recognized in Europe and have adopted most of the European names for them. For the lesser units they have, as a rule, made their own divisions and coined their own names. The number of names is already large and is steadily increasing; no one could possibly learn them all without effort unduly great in proportion to the advantage gained. Even a casual inspection of a reasonably complete card file of American stratigraphic names or of a set of detailed correlation charts will be sufficient to demonstrate the number of terms involved and the intricacy of their relations.

The causes of the greater complexity of the American nomenclature are several. In rather minor part it is due to certain features in usage. To some extent names have been duplicated for entirely unrelated units; for certain names several or even many differing definitions have been accepted; different names have been applied to the same chronologic unit at different places; and different names have probably been applied to the same lithologic unit at different places. In major part, however, the complexity is due to the widespread acceptance of lithologic rather than faunal units as the basis of the nomenclature, a practice, which, because of the large area of the United States, its division into provinces with different geologic history, and the necessity for applying names in disconnected areas in advance of the solution of regional stratigraphic problems, has led to the

introduction of many names.

Powell,² in discussing many years ago the geologic maps made by the United States Geological Survey, stated very clearly a guiding principle of classification that seems to have represented

¹ See Wilmarth, M. G., The geologic time classification of the United States Geological Survey compared with other classifications: U. S. Geol. Survey Bull. 769, 1925.

² Powell, J. W., Methods of geologic cartography in use by the United States Geological Survey: Internat. Geol. Congress, 3d sess. (Berlin, 1885), Compt. rend., pp. 229–232, 1888.

the majority opinion then and even to-day sets forth fairly well the facts, if not the basis, of common practice in the United States. Powell wrote:

The maps are designed not so much for the specialists as for the people, who justly look to the official geologist for a classification, nomenclature, and system of convention so simple and expressive as to render his work immediately available alike to the theoretic physicist or astronomer, the practical engineer or miner, and the skilled agriculturist or artisan. * * * Accordingly, the classification involved in a cartographic system designed for general use should be objective rather than theoretic; it should be based upon rock masses in their observed and readily observable relations rather than upon time intervals contemplated in historic geology, or even upon the organic remains contemplated in biotic geology; it should be petrographic rather than chronologic or paleontologic. * * * But while the minor geologic divisions must therefore have a natural basis, those of greater magnitude may be somewhat differently defined. The structural geologic unit is the "formation." It is defined primarily by petrography and secondarily by paleontology; and, in thoroughly studied regions, is generally found to constitute a genetic unit.

That there are certain disadvantages in the extensive use of lithologic units is obvious. It leads to the multiplication of local names, for example. Where changes in lithology are numerous a detailed "lithologic" nomenclature is apt to be so intricate as to approach the impracticable. There then arises a tendency to use rather thick, indefinitely defined units and often a tendency to attempt to extend the application of these units over large areas because of this same indefiniteness. One of the results is that certain names come to have little meaning unless specific localities are stated.

The use of lithologic units, as noted in the quotation from Powell, is based primarily on practical considerations. To most American geologists the principal purpose of a division of the rocks is to afford units that can most conveniently and most rapidly be recognized in the field and recorded on a map. Very often the geologist's interest is centered in the mineral resources or structural geology of a local area, where the relations of the rocks with those of remote, better-known areas are not of urgent importance. Usually he has only moderate acquaintance with paleontology and finds difficulty in using faunal criteria, even though fossils may be available. In some areas fossils are either very rare or lacking through considerable thicknesses of strata or belong to groups not well enough known to be useful. In many areas only the general features of the stratigraphy and paleontology are known, and sure correlation with units of other areas is not possible. Under these conditions local units based on lithology are by far the most serviceable.

Some of the lithologic units are, to be sure, also essentially faunal units, but this is mostly either the result of an accident in the original selection of stratigraphic boundaries or of a minor

shifting of boundaries as information is acquired in subsequent work. A few purely faunal units have been separated and treated just as if they were lithologic units, though difficulties have been met when in later work this original faunal basis of division has been overlooked by geologists more familiar with a lithologic basis. For other units a classification into faunal zones has been superimposed on a fundamentally lithologic classification and an attempt made to consider both in the stratigraphy. It nevertheless remains true as a general statement that the smaller units of American stratigraphy are con-

venient map units based on lithologic features.

In spite of the difficulties and of the weaknesses of the American system of nomenclature, there appears at present to be no feasible substitute. It may, in fact, have, besides the practical basis, at least one important theoretical justification. Lithologic units, by and large, are likely to approximate environmental units, and changes of environment in space and time are a most significant aspect of geologic history. The emphasis on lithologic differences inherent in this system of nomenclature may hence in part compensate its obvious disadvantage of complexity. Perhaps in time it will be possible to replace this lithologic system by a simpler and more nearly universal system of chronologic units based on faunal features, but at the present day, even where studies have advanced farthest toward a faunal-chronologic classification, the lithologic groupings of the earlier work are still useful.

TIME TERMS AND ROCK TERMS

Usage with regard to time and rock terms is by no means uniform in the United States. There is general agreement upon the use of "era" for the major time divisions, but no term for the corresponding rock divisions has had wide acceptance. "Group" has been used in this sense, but it has had other uses, one of which is rather general, and therefore seems inappropriate. The divisions of an era are always called "periods," and the corresponding rock units are always called "systems." Some writers recognize "suberas" containing several periods, but this usage is not general. A period is divided into "epochs," and the corresponding rock units are "series," though both of these terms have been loosely used for smaller units. "Epoch," for example, is used by the United States Geological Survey for any division of time less than a period, though it is more common in everyday practice to use "time" in this sense—for example, "Oriskany time." Of the rock units less inclusive than series the most important is the "formation." Two or more formations may

be associated in a "group," ordinarily much thinner than a series, and within a formation subordinate named units called "members," "lentils," or "tongues" may be recognized. "Age," for a specific time unit, and "stage," for a rock unit, have been little used in America. "Horizon" has been used occasionally as if it were a material stratigraphic unit, but as in a strict sense a horizon has no thickness, meaning simply position, that usage is inappropriate.

The official classification of the United States Geological Survey recognizes, in descending order of importance, the following

terms:

Time Rock

Era_____

Period_____ System.

Epoch_____ Group.

Epoch_____ Formation.

Epoch_____ Member, lentil, tongue.

DISCRIMINATION AND NAMING OF FORMATIONS

In American stratigraphy the formation is taken to be the fundamental unit of mapping. The concept of this unit is rather elastic, and no standard definition can be offered. It may be as simple an aggregate as a single uniform bed of rock or a succession of beds of like sediments. It may be with equal propriety an alternation of beds of unlike sediments, such as sandstone and shale, included between two breaks in the continuity of sedimentation or between two horizons where there is marked change in the aggregate lithology or some other evidence of important geologic events. Less commonly it consists of several beds grouped together because they contain throughout a related fauna, though not necessarily displaying lithologic unity. In brief, a formation may be any aggregation of beds that contains no important interruption and is bound together by some lithologic, stratigraphic, or faunal tie. In actual practice of field study or mapping, expedience or utility may be the deciding factor.

The thickness of a formation or the length of time it may represent is not an essential feature. A single sequence might conceivably contain a formation thousands of feet thick and another only a few feet thick. The first might contain members each many times thicker than the entire second formation; or the second might be divided into several members and the first be undivided. It is perhaps more often the case that the selection of boundaries is influenced by the necessities of cartographic

representation and that the units selected in a given area are

more nearly comparable in thickness.

In naming formations it is the most general practice to adopt a geographic name derived from a "type locality" where the formation is present and sufficiently well exposed to constitute a standard of comparison. In practice it not infrequently happens that subsequent work reveals a better or more complete exposure than the type locality, and recourse is had to this as the actual standard rather than to the technical type locality. The geographic name originally selected, however, still stands as the valid name and is combined with either a lithologic term, if the formation is predominantly of one kind of rock, or the word "formation," if no single term is appropriate. This yields names like Dakota sandstone, Trenton limestone, Austin chalk, Genesee shale, Navarro formation, Dunkard formation, and Teion formation. In general, priority in names is respected, and duplication of names is avoided, though no such rigidity of usage prevails as in biologic nomenclature; and it is sometimes expedient, where general use has established a later name, to waive consideration of priority and, where suitable names are scarce and the areas are widely separated, to accept a duplication.

Members, lentils, and tongues are smaller units essentially like formations and are discriminated and named in the same manner as formations. Indeed, it is not uncommon practice to consider a given set of beds in one area as a formation containing members and in another area as a group containing formations. It is entirely possible that in a third area this same set of beds might be considered a member of another formation of large scope. The same geographic name could be applied to the beds, whether they were viewed as a group, a formation, or a member. This elasticity of usage has its valuable aspects.

but it is also a source of confusion.

A special type of name that should perhaps be noted here is that constituted by the naming of individual coal beds, fire-clay beds, oil sands, and comparable items. These names are confined usually to purely local units. They are applied by mine operators, drillers, economic geologists, or others connected with the mineral industry, and they are not often taken up in discussions of geologic nomenclature.

In extending the application of a name away from the type locality it is the general practice to apply it only to deposits similar in lithology to those of the type locality and supposedly continuous with the type locality, now or in the past. It is not the present practice to extend a name to extreme distances. Deposits that may be synchronous with those of the type local-

ity but are of different lithology are commonly given another name, and likewise those at a great distance. This is at variance with the common European practice of putting a geographic name into an adjectival form and extending it widely, without regard to lithology, to all deposits supposed to be synchronous with those to which the name was first applied—for example, Montian (calcaire de Mons). The adjective form is used also in America but only for the larger divisions and always with the implication that a time unit is intended.

CORRELATION TABLES

The appended series of tables (pls. 1–10) embodies a tentative correlation of representative local American systems of nomenclature for Paleozoic, Mesozoic, and Cenozoic rocks. On the left of each table is shown a European system of nomenclature, which, it is believed, will help those more familiar with it to date the units used in the United States. No attempt at completeness has been made, for complete tables would be too large to be practically useful, and indeed it is doubtful whether sufficient information is available to make even reasonably

complete tables possible.

The conventions used are those commonly employed. Each vertical column represents a more or less local sequence—that recognized in the geographic unit indicated at the head of the column. Position within the columns represents relative age, the oldest unit at the bottom and the youngest unit at the top. Units alined horizontally are of the same age. Absence of rocks of a given age is represented by a ruled space in the part of the vertical column corresponding to the age. Vertical position does not imply relative thickness nor relative length of time. A query (?) placed on a line indicates doubt as to the vertical position of the line—that is, doubt as to the age of the feature for which it stands.

The correlations shown in the tables depart in some details from the official classification of the United States Geological Survey. These departures represent to some extent the opinions of the individual compilers and also to some extent the opinions of authors who are not members of the United States

Geological Survey.



5	eralized ection, it Britain	Generalized Section, United States	Vermont	Hudson River Valley	Southeastern Pennsvlvania	Southern Appalachians Virginia to Alabama	Upper Mississippi Valley	Ozark	Oklahoma, Texas	Dakota Wyoming Colorado	Grand Canyon, Arizona	Northern Wasalch Mountains	Eastern part Great Basin	Western part of . Great Basin	Southwestern Montana (composite)	Canadian Rocky. Mountains
? 7	remadoc .	Lower Ordovician (Canadian)	Georgia shale (Canadian)	Schagticoke (Canadian)							Devonian or Carboniferous	(Canadian)				
1	robably vanting n Great Britain	States) Ozarkian of E.O. Ulrich Tower	Represented by several			Chepulte pec dolomite Copper Ridge dolomite Bibb dolomite Ketolomite Brierfield dolomite	Madisan sandstone Mendota dolomite	Gasconade dolomite Van Buren formation Proctor dolomite Eminence dolomite Potosi dolomite	So Ellen-	Interval rep- sented in Manitou lime stone, in part		Represented in the St. Charles formation	Upper part of Notch Peak formation			Mons formation Represented
erus serie	Petura	Trempealeau formation	formations			Represented ??	Jordan ss., Norwalk ss., No Myers Hills. Lodi Shale StLawrence dolomite Lingula Winona zone	5.	Signal (Nountain) He (Ohio-Texas) Royer (Oklahoma) L Ft. Sill O (OklaTexas)				Hamburg shale		Represented	
la flags or C	Orusia beds	Ter Cambrian formation	Highgate Shale				Mazomanie sandstone Franconia formation	Doe Run, dolomite Derby dolomite Davis formation	Honey Creek formation (Oklahoma) = Wilberns formation	Deadwood		St.Charles formation	Secret Canyon shale	Represented	Dry Creek	Sabine . formation
(Lingu	?	Ironton : formation Eau Claire formation	Mill River conglomerate	Essex County "Potsdam" sandstone	Represented	-Nolichucky shale Maryville Jimestone	Ironton . formation Dresbach sandstone Eau Claire formation	Bonneterre dolomite	Cap Mountai	Probably several gaps in the sequence it of Rocky Mountain from	£-	Nounan .	Orr formation Weeks formation	?	Shale Pilarim Pilarimestone	Sherbrooke formation Paget formation
series)	P. forcham meri ?	Stephen, formation	st. Albans shale (Centropleura)				Mt.Simon Sandstone	Lamotte	Reagan Sand- stone, Bliss sandstone, etc.	lower part of Deadwood	Muav o shale o Bright o Angel o Shale	Bloomington formation	Marjum. formation Wheeler. formation	7	Purk shale Meagher Is_ Woolsey shale	Arctomys formation Eldon formation Stephan formation
Paradoxides s	P. tessini	Cathedral formation Ute formation Ptarmigan formation	7		Elbrook . formation	Rutledge Immestone or Elbrook formation					0,	Langston	Swazey formation Dome formation Howell formation Unnamed Chisholm Formation	Represented Harkless sandstone		Cathedral formation Ptarmigan formation Represented
7 7 7	- P. ilandicus Lapworthella Protolenus	Chisholm formation Rome				Represented Rome . formation						Brigham, formation	Formation			U. Mt. Whyte formation
Lower Series)	Callavia	Shady limestone	Milton limestone Cokhester shale Mallett, dolomite	Troy sh, and is Diamond Roc quartzite Nassau bed Schodack Shale and limestone Bomoseen	Kinzers formation Vintage dolomite	Shady dolomite						Represente in the southern Wasatch	Prospect Mountain quartzite	Silver Peal	+	L. Mt. Whyte formation St. Piran. formation Lake Louise
(Olen	rekin.	Erwin quartzite Hampton shake		grit grit	Antietam sandstone Harpers schist Chickies or Weverton gtz	Erwin quartzite Hampton Shale Unicoi formation										Shale Fort Mountain formation

Wrekin.

quartzite

Quicoi
formation

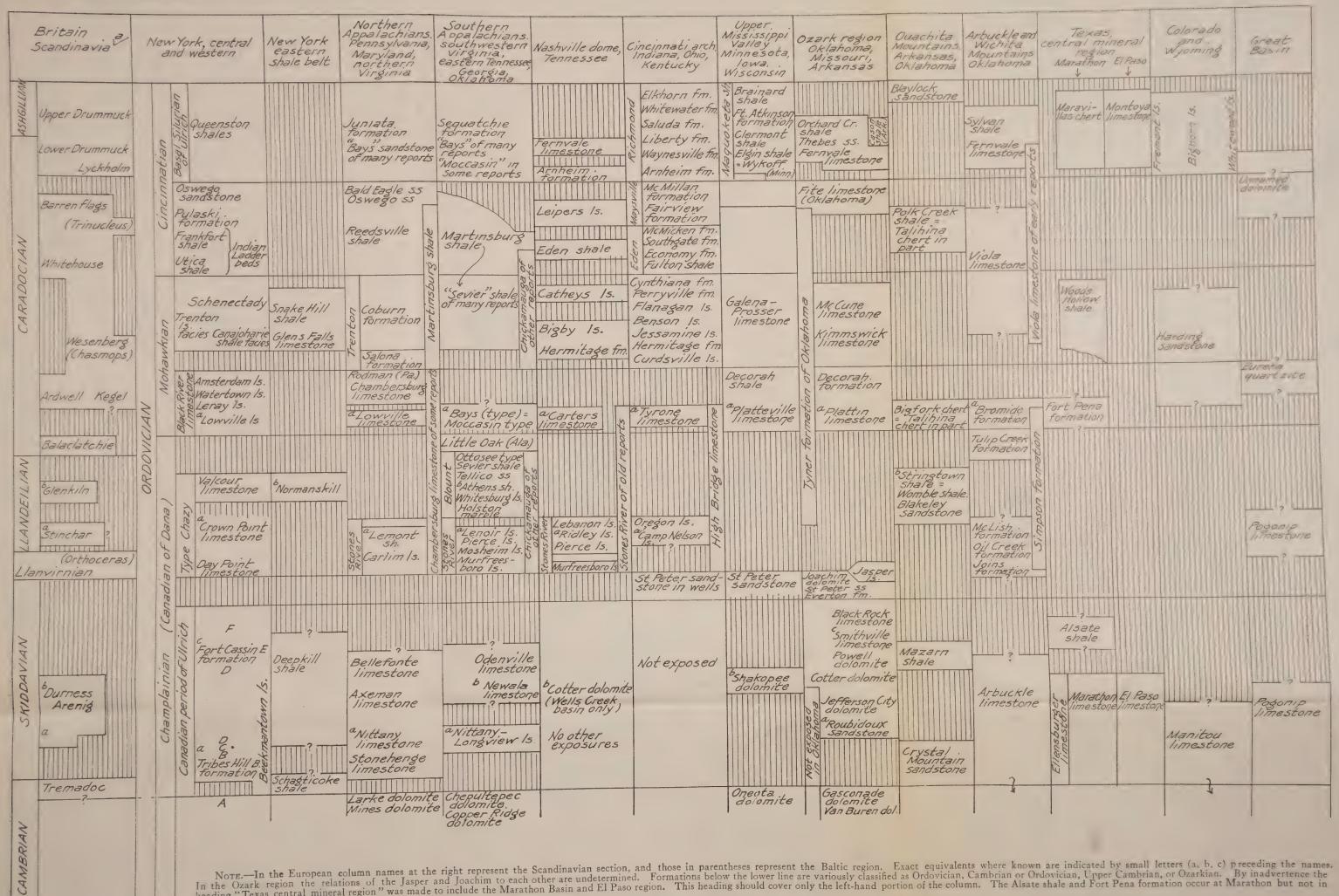
Chickies or
Weverton qtz. Unicoi
formation

Weverton qtz. Unicoi
formation

According to E. O. Ulrich the Fort Sill, Royer, and Signal Mountain formations should be placed in the Lower Ozarkian above the Trempealeau and below the Potosi.

TENTATIVE COPPELATION OF THE CAMBRIAN FORM.





Note.—In the European column names at the right represent the Scandinavian section, and those in parentheses represent the Baltic region. Exact equivalents where known are indicated by small letters (a, b, c) preceding the names. Note.—In the European column names at the right represent the Scandinavian section, and those in parentheses represent the Baltic region. Exact equivalents where known are indicated by small letters (a, b, c) preceding the names. In the Ozark region the relations of the Jasper and Joachim to each other are undetermined. Formations below the lower line are variously classified as Ordovician, Cambrian or Ordovician, Upper Cambrian, or Ozarkian. By inadvertence the lower line are variously classified as Ordovician, Cambrian or Ordovician, Upper Cambrian, or Ozarkian. By inadvertence the lower line are variously classified as Ordovician, Cambrian or Ordovician, Upper Cambrian, or Ozarkian. By inadvertence the lower line are variously classified as Ordovician, Cambrian or Ordovician, Upper Cambrian, or Ozarkian. By inadvertence the lower line are variously classified as Ordovician, Cambrian or Ordovician, Upper Cambrian, or Ozarkian. By inadvertence the lower line are variously classified as Ordovician, Cambrian or Ordovician, Cambrian or Ozarkian. By inadvertence the lower line are variously classified as Ordovician, Cambrian or Ozarkian. By inadvertence the lower line are variously classified as Ordovician, Cambrian or Ozarkian. By inadvertence the lower line are variously classified as Ordovician, Cambrian or Ozarkian or Ozarkian. the central mineral region.



		_		14=/									PLATE 3
Overlying rocks	9	Europe	New York	Maryland Pennsylvania	Eastern Tennessee	Ohio	Western Tennessee	Missouri	Eastern. Wisconsin	Central-Southern Oxlahoma	Utah - Idaho	Nevada	New Mexico
FOCKS			Lower. Devonian	Devonian	Lower. Devonian	Middle	Lower. Devonian	Devonian	Middle Devonian	Lower. Devonian	Middle Devonian	Middle	Upper Devonian
SILURIAN	Downtonian (?)	Downtonian	Manlius limestone Rondout waterlime Cobleskill limestone	Tonoloway limestone Wills Creek shale		Northern Ohio Detroit River series (Upper Monroe) Sylvania sandstone	-						
NPPER	000	Upper Ludlow	Salina formation	(Bloomsburg Sandstone) McKenzie formation	Sneedville limestane	Bass Island series (Lower Monrae) Greenfield dolomite	Decatur Timestone		Waubakee Vimestone				
E SILURIAN	10pian	Aymestry Lower Ludlow	Lockport dolomite fincluding Guelph dolomite)		?Louisville limestone	Central Ohio to Louisville, Ky Louisville limestone Waldron shale Laurel limestone	Lobelville limestane Bob Beech Riv Is. Dixon limestane Lego limestane Waldron shale Laurel limestone	Bainbridge Vimestone	Guelphi dolomite ? Racine dolomite (Hopkinton dol. of lowa) Waukesha dol.	Henryhouse shale Middle Hunton (pars) St Clair Imestone (N.E. Okiahoma)	?	?	?
MIDDL	53,	Wenlock	Clinton beds Rochester Shale? Irondequoit limestone, etc.	Rochester formation Rose Hill formation		Osgood limestone	Ostood limestone		Mayville dolomite		Laketown dolomite	Lone Mountain dolomite	Fusselman dolomite
	Tue	Upper	Upper Medina sandstone		Brassfield supspures	Brassfield limestone	Brassfield Jimestone	Brassfield limestone (Sexton Creek)		Chimney Hill limestone (Lower Hunton)			
WER 5/20	Hentian or Llandove	Middle	Medinan (Albion)	Tuscarora sandstone (Medina)	White Oak Sully sandstone			Eddewood (Imestone (Noix oolite) Girardeau limestone					
	70	Lower	Albion sandstone					(/2227	Iron Ridge iron ore	(Inner	Upper	Upper	Upper
rocks (Ora	Upper. dovician	Ordovician	Upper Ordovician	Ordovician	Upper Ordovician	Ordovician	Ordovician	Ordovician	Ordovician	Ordovician	Ordovician	Ordovician



	Europe	New York	Pennsylvania	Southern Ohio and Indiana	Western Tennessee	Missouri	lowa	Michigan.	Colorado	Montana Utah,	Central Nevada	Arizona
Over- lying		Carboniferous	Carboniferous	Carboniferous	Carboniferous	Carboniferous	Lower Carboniferous	Lower	Lower	Carboniferous	Lower	Carbon, Ferous
r Devonian	Famennian	Chemung formation	Jennings formation			Central Missoun		7.	Chaffee formation (Central Colorado) Elbert Ouray 55, 15,			
yoper	Frasnian	Portage form		New Albany Shale	Hardin sandstone	Snyder Creek shale	Lime Creek shale (Hackberry shale)	Antrim shale		Three Forks shale	1111111 5 111111	Martin Imestone
		shale Tully limestone	?				State Quarry limestone	?		?	restone	7
Декопіап	Givetian	Hamilton formation		Sellersburg Timestone		Callaway Ilmestone Mineola Ilmestone Southeastern Missouri St.Laurent Ilmestone	Cedar Valley limestone Wapsipinican limestone	Traverse group		Jefferson Jimestone	Nevada lin	
Middle	Eifelian (Couvinian)	Marcellus shale UB Shale Onondaga limestone	Romney shale	Jeffersonville limestone	Camden ·	Grand Tower Iimestone		Dundee Iimestone			7	
	Emsian (Coblentzian)	Esopus grit Esopus grit			chert							
Lower Devonian	Siegenian (Gedinnian)	Becraft limestone New Scatland limestone Coeymans	Oriskany sandstone Becraft limestone New Scotland limestone Coeymans limestone		Harriman chert Decaturville chert Birdsong Shale	limestone						
Under- lying		Voner Manlius	Keyser limestone Upper Silurian	Middle Silurian	Rockhouse Shale Upper Silurian	Middle Silurian	Vpper Silurian	Upper Sijurian	Upper Ordovicia to pre-Cambria	MMiddle Silurian to Cambrian	Middle Silurian	Upper, Cambrian



An attempt is made to employ divisions most widely accepted in Europe without any decision as to their validity.

**Correlations are very tentative and at present in dispute.

**These standards are tentative and not official.

**In the United States equals the Carboniferous and Permian of Europe. In the United States equals the Carboniferous and Permian of Europe. As will be readily seen, many of the sections are composite.

**The Carboniferous of the United States equals the Carboniferous and Permian of Europe. In the United States equals the Carboniferous and Permian of Europe. In the United States equals the Carboniferous of the United States equals the Carboniferous and Permian of Europe. In the United States equals the Carboniferous of the United States equals the Carboniferous and Permian of Europe. In the United States equals the Carboniferous of the United States equals the Carboniferous and Permian of Europe. In the United States equals the Carboniferous of the United States equals the Carboniferous and Permian of Europe. In the United States equals the Carboniferous of the United States equals the Carboniferous and Permian of Europe. In the United States equals the Carboniferous of the Uni



	6	Eu	IFO IIV	pean alents	California	Nevada	Idaho	Northern Utah	Arizona and southern Utah	Colorado	Wyoming	Texas	Atlantic States
		aric		Rhaetic	?	? ,	Wood shale	•	?	?		?	?
	Ipper	Bajura	uper	Noric	Brock Pseudor shale tis zon Hosselkus Coral z	ne	Deadman limestone Higham	Ankareh formation	Chinle formation	Dolores Formation		Dockum group	Newark group
	7	1,0	Te	Karnic	limestone Tropic zone	Star Peak	grit Timothy	- 2	Shinarump cong		Popo Agre		
5510		Tirol		Ladinic	Pit						and Jelm formations		
TRIAS	idalle	2/2	HOHIS	Anisic	shale Daone Zone			?			?		
	N	Dina	Musch	Hydaspic			Portneuf formation	Emigra-			?		
	ower	Ithic	Bunter	Jukutic	Unnamed Meekock beds zone	,, 090,,,,,,,,,	Fort Hall fm. ? Ross Fork fm.	Services of the services of th	Moenkopi formation		Chugwater formation		
	07	56)	7	Brahmanic			Woodside formation	Woodside formation			Dinwoody formation		

TENTATIVE CORRELATION OF THE TRIASSIC FORMATIONS

Compiled by John B. Reeside, jr.



		European equivalents	California	Oregon	Nevada	Idaho	Northern Utah	Eastern Utah	Colorado	Wyoming	Montana	Texas
		Tithonian	Unnamed beds					?	? 10	?		
		Portlandian				2	Morrison formation	Morrison formation	Morrison San Form.	Morrison formation		Malone
	Ser	Kimmeridgian	00 20	Galice sh.		Stump ss.	? —	7	stare	7		formation
	dol	Argovian	Foreman de the formation	Dotham ss.		Preuss ss.	T C/	Summerville formation Curtis formation	forman makes and	Sundance		
		Divesian		?		Twin Creek Imestone	Imestone	Entrada Sandstone			Ell15	
S		Callovian	Hinchman tuff Bicknell ss.					Carmel form.			formation	
五ついく	16	Bathonian	Unnamed	7		Nugget sandstone	Nugget	Nava jo sandstone				
700	Midd	Bajocian	Morman ss. formation Thompson Is. Fant andesite Bagley andes	,		Salloscorie	2	Sanostorje				
								Mayenta form.				
		Toarcian	sandstone ?					Cany				
	79	. Charmouthian	?					Wingate Sandstone				
	Lowe	Se Pliensbachian	formation Sailor		Unnamed							
		Sinemurian	Canyon formation		beds							
		Hettangian						2				



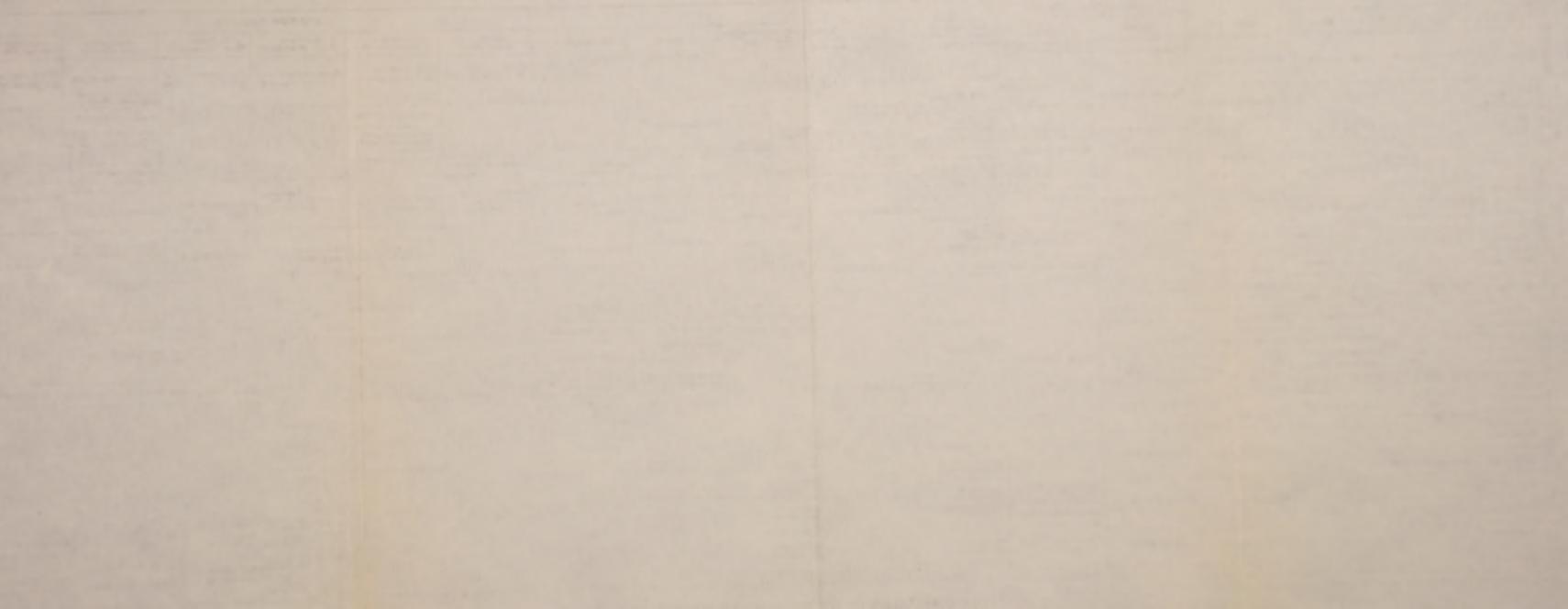
							/	NTERIO	R REGIO	DN .					GULF	AND AT	LANTIC CO	OASTAL A	REGION	
		European equivalents	Pacific Coast	San Juan Basin, . New Mexico and Colorado	Eastern Utah	Western Wyoming	Western Montana	Central Colorado	Central Wyoming	Central Montana	Kansas	Black Hills	Central Dakotas	Southwest Texas	North Texas	Arkansas	Mississippi	Alabama	The Carolinas	Maryland and Delaware
		Danian (ª		Ojo Alamo and Animas formations	a) Price		St Mary River	Denver formation Arapahoe fm.	12060	/		lance formation	Ludlow m. Hell Creck							
		Maestrichtian		Mc Dermott fin Kirtland shake Fruitland fin Pictured Cliffs Lewis	formation	Adaville formation	Horsethief ss.	fox Hills sandstone	Lewis Shale	Lennep ss. Bearpaw shale	?	Fox Hills Sandstone	Fox Hills	TOFMACION	Navarro formation	Saratoga	formation	Ripley	Peedee formation	Monmouth formation
		Campanian		Mesaverde group variously	Blackhawk fm Star Fount fm	? !!!!	Two Medicine formation Virgelle ss.	Several Sandstone Members	Mesaverde formation	Judith River formation Claggett sh. Eagle Sandstone	Pierre shale	Pierre Shale	Pierre Shale	San Miguel formation	Taylor	Marlbrook marl Annona Chalk Ozan.		or macron		Matawan formation
	PPER	Santonian		divided locally	Mancos Shale, containing	Hilliard shale	Colorado	Apishapa	shale	Telegraph Creek fin	Smoky Hill			Upson	Austin chalk	Brownstown mar/	Eutaw formation	EUTAW	Black Creek formation	Magothy
5	7)	Coniacian	?	Mancos shale, containing	Several members locally	?	shale containing several members locally	member Timpas Oil member member		Warm Creek Shale	Chalk m.	formation	Niobrara formation	Austin chalk	Chark	Tokio formation			2	2
CEOU		Turonian	Chico Formation	several members		Frontier sandstone Aspen shale	2	Shale	Frontier ss.	Mowry st.	Carlile Shale Greenhorn limestone	, Pe / 25.	Carlile shale Greenhom	Eagle Ford clay	Eagle Ford Clay		Tuscaloosa formation	Tuscaloosa formation	Middendort formation	
PETA		Cenomanian	2	Dakota (?) Sandstone (upper part)	Dakota(?) sandstone	Bear River formation		Shale Dakota sandstone	Thermopolis Shele Cloverly formation (upper part)	Thermopolis Shale?	Dakota	Nowry shin Nelsy shin Newcastle Sandstone	Dakota	?	Woodbine sand	Sand	?	?	?	Raritan
5		Albian	Horsetown Formation					Purgatoire Formation			Belvidere formation Cheyenne ss.	skull Cr. sh. m. Fall River ss.		group Fredericks	Washita group Fredericks burg group	Washita group Fredericks burg group				Patapsco formation
	IER	Aptian		Dakota(?) sandstone			Kootenai formation		Cloverly formation	Kontenai		Fuson sh.		Trinity group	Trinity group	Trinity group				??
	LOWER	Barremian Hauterivian K Valanginian Berriasian		(lower part)			?		(lowerpart)	7. — — — — — — — — — — — — — — — — — — —		Lakota 55.								Patuxent formation

The correlation of formations here shown as of Danian age is much disputed. In the legend of the geologic map of the United States and in the official classification of the United States Geological Survey the Ojo Alamo, Animas, and Lance formations are placed in the Eocene (?) and the Arapahoe and Denver formations are placed in the Eocene.



			COASTA	AL REGIONS							INTERIOR RE	EGIONS		
European stages	Maryland, Virginia, Florid	a Alabama	Texas	Southern California	San Joaquin Valley, California	Central Coast Ranges, San Franci California Califo	isco region, Oregon	Washington	Southern . Great Basin	Northern . Great Basin	Southern Rocky Mountains	Northern Rocky Mountains	Southern Great Plains	Northern Great Plains
PLEIS TOCENE	Terrace deposits Terrace dep	osits Terrace deposits	Beaumont clay	Palos Verdes sand and other marine terrace deposits San Pedro sand and other marine deposits	?	Mesritt sa San Antoni	and formation Terrace deposits	Terrace deposits	River terrace and lake deposits	River terrace and lare usposits	River texfore and glacial deposits	Averturgen and	When terraces	River terrace and flacial deposits
Je leenian Sutleyan Newbournian Waltonian		Citronelle formatio	Reynosa formation	Pico formation	Tulare formation / Kern River formation	Paso Robles formation Merced.	Berkeley group Elk River beds			Rattlesname and Thousand Creek	5		3 2 w terrat en	
Gedgravian Lennamian	Waccamaw marl Yorktown Duplinmar		Lagarto clay	Repetto formation	Tormarion Turn	San Pablo	Orinda formation ??	ACCILIOIT.	Ricardo formation	formations Lienstung formation	7		-1,	Faxvine graver
Sarmatian Sarmatian	St. Marys formation Chockawhat		Oakville sandstone	Modelo .		Santa Margarita formación a Monterey Stiale Montere	Briones	Montesano formation	Barstow and Esmeralda formations	Esmeralda formation	Santa fe Browns formation formation	Mad son Valley	6, 21 e.700.7 60 cis	1 2
Tortonian Helvetian	Calvert formation Oak Grove for	nation	?	Topanga Rincon formation Shale	BigBlue servents - ous mem. Temblor formation		Astoria formatio	Clallam formation		Mascall, virgin Valley, and Payette formation	Florissant lake bees	Furt Creek beds	PANNER CENT STE 6.18 SHARE 1 66K 6.25	Teep River
Burdisalian Aquitanian		Catahoula	Catahoula sandstone	Vaqueros sandstone	Vagueros formation fecuya		?	2	Phillips Rasch bed				Lower Snake Creek beds Upper Rosebud beds Lower Rosebud heds	
Chattian Chattian Rupelian	Byram mar				San Emigdion	Concord fü Kirker tu San Ramo	Nye shale V Pittsburg Blyff sandstone	Blakeley formation Lincoln formation	3	John Day formatio	77		Monument Creek	
20170 Latterfian	Marianna lii	mestone Marianna limestone		Sespe formation	Kreyer	7-	Bässendorf shale and Keasey shale	Gries Ranch beds		?		Wnite River group	White River group	White River group
Ludian Bartonian	Castle Hayne marl	Jackson Formation Ocala Innestone	Jackson group		Shale ?		?,	Cowlitz 3	nation :		Uinta formation "Washakie	ਹਾ 2		
Auversian Lutetian	Nanjemoy formation	Claiborne group	Claiborne group	??	Tejon formation Domengine a formation	Domers:	ine Arago formation		Uset for	Clarno formation	Green River			
Ypresian Sparnacian	- Aquia formation	Wilcox group	Wilcox group	Santa Susana shale	Meganos formation	Megano formation			?-	7117117	formation wind Rive. Wasatch Hannation formation formation	Wasatch formation	Poison Canyon	Wasaten formation
Thanetian Nontian Montian		Midway group	Midway group	Martinez formation	Martinez formation	formation Martine					torrejond formation of formation formation	Formation Some	Poison Canyon formation Raton formation	Fort Union Formation

^a Names that have not been adopted by the United States Geological Survey.



7X	European Alps (Penckand Brückner)	(Matthes)	Sierra Nevada (east flank) (Blackwelder)	San Juan Mountains, Colorado (Atwood, Mather)	Puget Sound region, Washington (Willis, Smith, Bretz)	Eastern Washington (Bretz)	Montana (Alden Pardee Anderson)	Mountains, northwestern "Wyoming southeastern Idaho (Blackwelder)	Montana, northwestern (North Dakota, western Wyoming (Alden)	Grea Geo (C)	er Mississippi Basin and Lakes region U.S. plogical Survey hamberlin, everettet al)	Minnesota, eastern Dakotas, northwestem Iowa	Minnesota, northeastern	fo Bas	Recently programmer with the second s	Lakes region (Leighton)	Ohio, western, Pennsylvania (Leverett)	(Salisbury,	New York (Fuller)	New England Islands, Cape Cod (Woodworth, Wigglesworth)
FECE	Recent	Mountain glaciers and streams	Mountain glaciers and streams	Mountain glaciers and streams	Mountain glaciers and streams	Stream5	Mountain glaciers and streams Wisconsin	Mountain glaciers and streams	Mountain glaciers and streams Wisconsin		Streams Wisconsin	Lakes and streams Wisconsin	wisconsin Wisconsin	5	Pecent tage Wisconsin	Recent epoch Wisconsin	Lakes and streams Wisconsin	Wisconsin	Glacial	Glacial
	Wűrm glacial epoch	Wisconsin glacial stage	Tahoe glacial stage	Wisconsin glacial stage	VASHON EPOCH Washon dacial drift (Puget Sound) Osceola glacial drift (of Gascao glaciers)	Wisconsin glacial stage (lakes and	glacial stage and glacial Lakes Kootenai	Pinedale glacial stage	glacial stage Late and middle or early (?) of Keewatin ice sheet and mountain glaciers		glacial stage. Late, middle, early. glacial lakes	stage of Keewatin ice. late (Lake Agassiz per Upham)	glacial stage. Late Keewatin and Patrician.	ELDORAN EPOCI	glacial stage Mankato ? (loess) lowan	Slacial stage Mankato Cary , (loess) Tazewell (loess)	glacial stage Late Middle Early	glacial stage	stage Late? Harbor Hill Substage Ronkonkoma substage	stage Late? Falmouth substage Nantwoket substage
	Würm-Riss interglacial	Cycle of erosion	Cycle of erosion	Cycle of erosion	Douty graves mountain glaciers	Palouse loess Cycle of erosion	Cycle of. erosion	(Loess in southeastern Idaho) Lenore cycle of erosion	imon or in inter- ial soil		Peprian interglacial lowarn glacial stage Sandamon interglacial stage	lowan stage of Keewatin ice sheet	(Loess) lowan stage of Keewatini	V EPUCH	(loess) Sangamon Interglacial stage	(loess) Sandamon interplacial stage	Peorian Interglacian (Ioess) Sangamon Interglacian Stage	Sangamon Interglacial Stage	Interplacial stage (erosion) (uplift)	Interglacial stage eroson and Vineyard formation (partly marine)
	Riss glacial epoch	?	Tioga glacial stage	Durango glacial stage	Puyallup Sand and lignite	Spokane glacial stage	Glacial stage (Mission moraine and glacial Lake Missoula) (Till at Ellistor on "No.2" terrace		Illinoian or lowan stage of Keewatin ice sheet and Recky Mountain glaciers?	ERIOD	Illinoian glacial stage	?	Illinoian stage of Patrician ice sheet	CENTRALIAI	(loess) Illinoian stage of Labrador ice sheet	Illinoian glacial stage	Illinojan glacial stage	Illinoian glacial stage (per Leverell)	Glacial state Hempstead (gravel) Montauk (till) Herod (gravel)	Hempstead (gravel) Wontauk (till) Herod (gravel)
EPOCH	Riss-Mindel Interglacial epoch	Cycle of erosion	Cycle of canyon erosion	Cycle of canyon erosion	do orting graval	?	Cycle of erosion (Canyons in mountains	Circle cycle of erosion	Cycle of erosion "No.2" terraces	TERNARY P	Yarmouth interglacian stage	Yarmouth interslación stage	Varmouth Interglacial Stage	EISTOCENE P	(loess) Yarmouth interflacial stage	A Yarmouth, interglacial stage		(erosion)	Transitional (Sand) Interglacial Gardiners (Clay) (Marine sub mergence)	Interspecial Gardiners
STOCENE	Mindel glacial epoch	El Portal glacial stage	Sherwin glacial stage	Florida group (partly outwash) Cerro glacial stage	Admiralty glacial till	Glacial stage? (Till at Cheney)	Glacial stage (till at Jocko and Helmville)	Buffalo glacial stage	Glacial stage (Till of Rocky Mountain glaciers on high No.1" predmont terrace,	QUA	Kansan glacial stage	Kansan glacial stage	Kansan glacial stage	OTTUMM	Kansan glacial stage	Kansan glacial stage	Glacial pebbles and boulder (extra- morainal)	Jerseyan glacial stage and Pensauken marine?? partial sub- mergence	(glacial? gravel)	Moshup till Coarse gravel Ferruginous boulder bed
PLE!	Mindel-Günz interélacial epoch	Cycle of canyon erosion	Cycle of erosion	Cycle of broad valley erosion	ADMIRAL.	?	Cycle of erosion	Black Rock cycle of erosion	Klacier Klational Park, near Helena, Castle Mountains. High till on Beartooth Mountains		Aftonian interglaciai stage	Aftonian Interglacia stage	Aftonian I interglacial stage	V EPOCH	Aftonian Interplacial stage	Aftonian interglacia stage	?	?	olnterglacia. stage. (erosion)	stage (erosion)
	Günz glacıal epoch	Glacier Point glacier stage	McGee glacial stage	?			Glacial stage (till at Pioneer and upper Madison River)		Glacial? boulder bed on Table Mountain, at Wind River and on, Moncrief Ridge at Big Horn Mountains		Nebraskan ģlacial staģe	Nebraska glacial stage	n Nebraskan glacial stage	GRANDIA	Nebraskan glacial stage	Nebraska glacial stage	?	?	Clacial stage CLAMannetto (glacial? gravel)	formation, glacul grave and till, folding due to ice push, weyquosque glacul sgr. Sankaty
	OLIGOCENE, MIOCENE, AND PLIOCENE	Cycle of erosion Uplift Cycle of erosion of broad valleys	? Pliocene Miocene	? (Uplift) SanJuan peneplain (cycle of erosion)			Erosion and 'No.1" terraces Uplift and faulting Bozeman 'lake beds' (intra- montane)	Union Pass cycle of erosion Fremont cycle of erosion (Sub summ, peneplain)	cycle of erosion. Broad mountain valleys and No.1"											marine sand. Dukes sald Dukes sald Dukes sald Dukes sald Dukes sald Dukes der bed Aquinnah constom- erate (Stream sald Fassils)

